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EDITORIAL

NEW TREATMENTS

We have continued to remind our readers of the important rôle of the Veterinary Profession in the national effort and offer no excuse for so doing except to indicate again how much may depend on its work during the coming months. It may seem to some of us that the amount an individual member of the profession can accomplish is of little significance and that in the absence of some organised effort our individual contributions are of small significance. We cannot subscribe to this view. While a well-organised national effort might be applied to the control of a limited number of diseases, of which the causes and methods of control have been fully studied and have been shown to be effective, there remains a field concerning which our knowledge is quite imperfect and others in which the methods of treatment and control vary with the individual case or outbreak. Knowledge, however, is accumulating all the time; new methods of treatment and control are being worked out. It is only by continuing to work along sound, scientific lines that we shall be in the position to alter some of the methods of dubious value and replace them by methods shown to be truly effective. Research work must, therefore, continue, special attention being given to problems likely to bear fruit in a reasonably short period of time. The purely laboratory aspect of research work may be apt to be stressed to the exclusion of the equally important field work which must accompany it. Laboratory findings must always be followed by field trials carried out under conditions of husbandry which may vary to a marked degree. It is not sufficient to select a number of "good" flocks or herds in which to carry out such trials; we must consider the types of animal husbandry as practised in different parts of the country. Without such field trials carried out under such conditions the results of careful research work in the laboratory may very easily fall into discredit when all that might be necessary would be some adjustment of the method to meet the various conditions in the field.

Let us then keep before us the fact that the acceptance of a new method of treatment or control must bear the hall-mark of experience of its use in the

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field under conditions which we are likely to meet in our everyday work. Until such proof is forthcoming we must rely on our present methods for general use, even though they be cumbersome and their results not so spectacular as we may desire.

Hard work on our cases may mean the saving of a life which might otherwise be lost. Every life is of importance, every live beast has an economic value to the country to-day. Each individual veterinary surgeon, be he research worker, practitioner or carrying out any other type of work in which the health and well-being of our livestock is concerned has a duty to perform as never before—the saving of animal life, the maintenance of animal health and the restoration of sick animals to ultimate health and productivity, when desirable. Let us see to it that we do not spare ourselves at this time to carry out our duty, keeping in front of us that newer methods of treatment must be vouched for by experience in the field before being accepted for universal application.

General Articles

THE VALVE OF THE FORAMEN OVALE AND ITS RELATION TO PULMONARY VEIN ENTRIES

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THIS paper is one of a series upon the fœtal circulation (Barclay *et al.*, 1939, 1941), the fœtal cardio-vascular system (Franklin *et al.*, 1940; Amoroso *et al.*, 1941, 1942), and the history of research in these fields (Franklin, 1941, *a*, *b*). Our objects in writing the paper are to present certain of the more important generalisations that have so far accrued from our comparative anatomical studies, and to stress in particular one feature, the functional significance of which has not hitherto been appreciated.

The communication is divided into the following parts :—

1. The range of our material.
2. The terminology employed, and reasons for its use.
3. Observations upon the valve of the foramen ovale.
4. Observations upon lung lobation.
5. Observations upon the pulmonary venous drainage, and the relation of certain pulmonary vein entries to the valve of the foramen ovale.

In our descriptions we shall use the terms *cranial* and *caudal*, *dorsal* and *sternal*, and *right* and *left*, as opposing terms in relation to the three planes of the animal body.

Material

Our material for the survey has been mainly mature, or fairly mature, fœtuses, but we have also used a few early post-natal specimens and one or two adult ones (the last in respect of lung lobation and pulmonary venous drainage only). In more detail what we have included in our investigations are :—

(1) *Marsupialia.* One pouch Bennett's wallaby (*Macropus ruficollis bennetti*); and one pouch red kangaroo (*Macropus rufus*). In these we find no trace of a foramen ovale, or pathway from the posterior vena cava to the left atrium, so they are included only in respect of lung lobation and pulmonary venous drainage.

(2) *Ungulata.* One African elephant fœtus (*Loxodonta africana*), estimated as ten months or, roughly, half-term (Amoroso *et al.*, 1941); many equine specimens (*Equus caballus*) from about 100 days, full-term being about 335-345 days, to one month post partum; one tapir (*Tapirus indicus*), stillborn; three hippopotamus fœtuses (*Hippopotamus amphibius*) varying in size and in their excellence of preservation, but between them sufficient for our story; many pigs (*Sus scrofa*), from about 70 days onwards, full-term being about 112-119 days; one camel fœtus (*Camelus dromedarius*), age unknown; two hog-deer (*Hyelaphus*

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porcinus), one ? full-term, the second five days post partum; many bovine specimens (*Bos taurus*) from three months to post partum, full-term being about 275-287 days; three goat fœtuses (*Capra hircus*) of unknown age, and one Caucasian goat fœtus (*Capra caucasica*) that was probably full-term; and many ovine specimens (*Ovis aries*) from about 115 days, full-term being approximately 147 days, to soon after birth.

In ungulates as a whole, and in equine, bovine, and ovine specimens in particular, we have been especially rich.

(3) *Cetacea.* One whale fœtus (*Pseudorca crassidens*). The specimen was about 110 cm. long and, for reasons into which we need not here enter, has not yet been fully dissected.

(4) *Carnivora.* Three cat fœtuses (*Felis domestica*) of seven weeks, full-term being about 60 days, and one specimen about three days post partum; one lion cub (*Felis leo*) about 24 hours post partum, and a second stillborn; one canine specimen (*Canis familiaris*) of approximately six weeks, full-term being about nine weeks, and two about 10 days post partum; two fox cubs (*Vulpes vulpes*) about two months post partum, and their mother; and one bear (*Ursus arctos*), 48 hours post partum.

(5) *Rodentia.* We have as yet examined only a few post-natal specimens, and these in respect of lung lobation and pulmonary venous drainage only.

(6) *Primates.* One ? mature lion marmoset fœtus (*Leontocebus rosalia*); one brown capuchin (*Cebus fatuellus*), two days post partum; two baboon fœtuses (*Papio papio*), age unknown; one *Macacus rhesus,* 24 hours post partum; one *Cercocebus fuliginosus,* just post partum; one colobus fœtus (*Colobus occidentalis*), age unknown; one gorilla fœtus (*Gorilla gorilla*), ? full-term, and an adult of four years; and seven human fœtuses (one ? four months, the rest viable) and one 14 hours post partum specimen. Only four of the human hearts came to us complete with lungs, and of these one (? four months) was too small for the investigation of the pulmonary veins; in only one human case was the fœtus fixed as a whole, in the others the viscera were fixed after exsection.

Obviously, we can speak with some confidence about only three orders of mammals, and even in respect of these our material is by no means fully representative, so that we must be prepared for exceptions to any general rules that we may put forward on the basis of our findings to date. On the other hand, the acquisition of further specimens is a matter of chance, and the publication of even provisional generalisations may be of considerable assistance in future studies. "For the Mind is so constructed that it can take little interest in the accumulation of instances unless it can adduce general laws therefrom" (Singer, 1931).

One of us (E.C.A.) is conducting embryological studies in respect of a few genera in order better to be able to explain the mature forms. But this attempt to discover the steps in the evolution of those final forms is likely to be prolonged and there is, in any case, no need for it to delay publication of our present study.

Terminology

As a result of our experimental, anatomical, and historical researches, we became convinced that it was necessary to introduce a new functional terminology

if we and others were to visualise correctly the inflow of blood into the fœtal heart and its distribution within that organ. The new terminology has been given elsewhere (Amoroso *et al.*, 1941), and we have also described in some detail the key-feature, namely, the division within the heart of the posterior caval stream (Amoroso *et al.*, 1942). We may, then, content ourselves here with a brief exposition of part of our schema (see Fig. 1). We postulate a *posterior* (*inferior*) *caval channel* going up (beyond the anatomical limits of the posterior vena cava) into the fœtal heart and therein dividing upon a marked ridge, which we name the *crista dividens* or *dividing ridge*, into *right* and *left terminal divisions*, of which the left is commonly the longer. This left terminal division (which is approximately the same as the "foramen ovale" in one of its four connotations; see Patten, 1931) is the channel by which posterior caval blood discharges into the left atrium. It is formed by a *fixed portion* (commonly part of the inter-atrial septum) and by a *free* or *apposable portion*, the so-called "valve of the foramen ovale." We do not like the term "foramen ovale," partly because it has four different connotations, but mainly because it focuses attention on the left-hand route for the posterior caval blood and so distracts it from a feature of much greater importance, namely, the bifurcation of the posterior caval channel into two terminal divisions (see Amoroso *et al.*, 1942). Further, the term "foramen ovale" has no physiological significance, and even as a description it is not perfect, for the foramen is often not oval. The term "valve of the foramen ovale" is also unsatisfactory, for, while the structure in question often resembles in appearance a single-cusp venous valve, in many ungulates it is extremely unlike a valve in any ordinary connotation of that word (see, e.g., Figs. 3 and 4). So far as its function is concerned, it either floats free between the posterior caval and pulmonary blood streams entering the left atrium, or else it is apposed and, according to its size, occludes partially or completely the left terminal division of the posterior caval channel. It is for this reason that we have renamed it the free or apposable portion of that division. It is normally apposed after birth, and our experimental records suggest that it can also be temporarily apposed in utero, though we are not yet in a position to assign a cause or causes to such transient intra-uterine appositions.

In the rest of this paper we shall use the following abbreviations:—

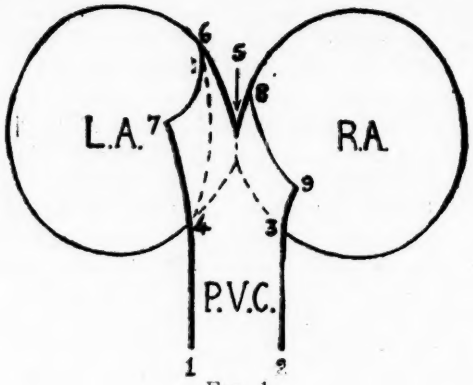
P.C.C. = Posterior (inferior) caval channel.
C.D. = Crista dividens.
L.T.D. = Left terminal division of the P.C.C.
R.T.D. = Right terminal division of the P.C.C.
F.P. = Fixed portion of the L.T.D.
A.P. = Apposable portion of the L.T.D.

The A.P., or Valve of the Foramen Ovale

With our terminology, so far as it concerns this paper, thus advanced and justified, we may proceed to observations on the L.T.D. and its A.P.

The lie of the L.T.D., in relation to the body as a whole, may be affected by:—

(1) The lie of the heart in relation to the dorso-sternal mid-line. In most fœtuses examined by us the apex of the heart has been near to, if not actually


6
5
8
L.A.
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R.A.
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P.V.C.
1
2

FIG. 1

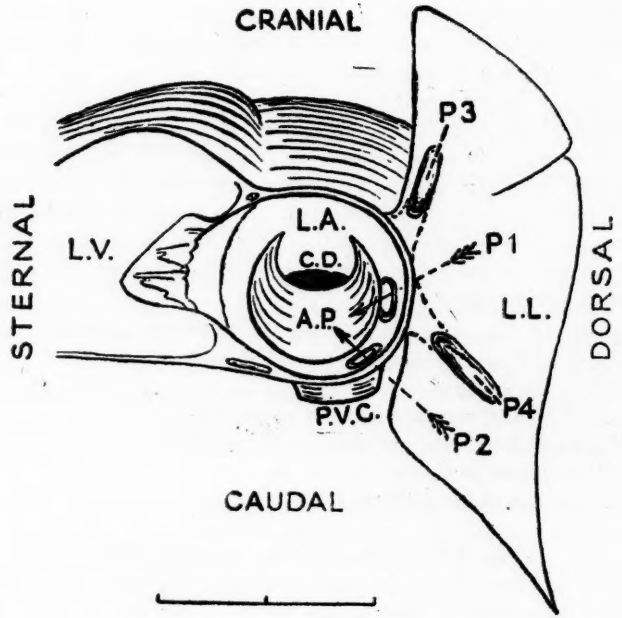
CRANIAL
P3
L.A.
L.V.
C.D.
P1
A.P.
L.L.
STERNAL
DORSAL
P.V.C.
P4
P2
CAUDAL

FIG. 2

next to, the mid-line of the sternum. In the human and gorilla fœtuses it has been well to the left, with a corresponding change in the lie of the whole organ.

(2) The fact that in some fœtuses the apex is more caudal, in relation to the rest of the heart, than in others.

The course of the L.T.D., in relation to the heart itself, may also vary as follows :—

(3) It may be relatively straight, or may curve slightly, or it may bend round so far that the blood stream leaves it almost at right angles to its original intra-caval course.

(4) It may pass due cranially, or incline somewhat sternally or dorsally from this line, as viewed from the left side.

In addition to the above possible variations of direction, the L.T.D. may remain of approximately the same calibre throughout its course, or it may gradually narrow, or it may narrow in its first part and thereafter remain fairly constant, or it may narrow and then open out again somewhat and finally be reduced again in calibre.

Obviously, the number of variables is very great, and at first glance it would appear that the A.P. has almost as protean a character as the L.T.D. of which it is part. But we are able to introduce at the outset a simplifying concept, namely, that the A.P. is of a fairly uniform type throughout our primates and carnivores, and departs from this type only in the ungulates; we are not able to speak of it in other orders of mammals.

The primate-carnivore type is diagrammatically pictured in Fig. 2, which is drawn from a human specimen. In such an A.P. we can differentiate free and attached borders, and sternal and dorsal cornua. To the right of the A.P. is the C.D. This simple type of A.P. can vary in the following ways :—

(1) In its dorso-sternal width.

(2) In its caudo-cranial length.

(3) In its inter-cornual distance.

(4) One or other cornu may be more cranial, or they may both be at the same level.

(5) In the slackness or tenseness of the membrane.

(6) In the degree of muscularity of the membrane.

(7) In the presence or absence of fenestration of the membrane; such fenestration is, actually, more common in ungulates.

(8) In the distances of the C.D. from the free and attached borders, both in the caudo-cranial plane and also laterally. If the middle of the C.D. is cranial to the middle of the free border, one can see through from the left into the right atrium or on to the Eustachian valve.

(9) The terminal parts of the cornua may, exceptionally, be mere ridges on the endocardium, in which case the terminations of the free border are not the same as those of the cornua, but caudal to these latter.

(10) The F.P. and A.P. respectively can contribute varying amounts to the total circumference of the L.T.D. entry into the left atrium.

It is clear, from the above list of variables, that even the primates and carnivores can show considerable variations in their A.P.s within the general

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type form. Even so, the mere existence of such a general type is an enormous simplification when one is investigating a large number of specimens.

In man (Fig. 2) the cornua may be more or less at the same level, or the dorsal one may be somewhat more cranial than the sternal one. The free border varies in its depth of curve according to the positions of the cornua and the degree of slackness of the membrane itself. In this connection we should, perhaps, remember that a membrane which post mortem appears slack may have been contracting and relaxing rhythmically during life at the same rate as the heart chambers (Barclay and Franklin, 1938; Barclay *et al.*, film record, 1939). In our gorilla fœtus, that we regard as full-term or practically so, the A.P. is a simple, slack flap, as in the less complicated human specimens, and the middle of its free border lies some distance caudal to the middle of the C.D., i.e., unless the A.P. had contracted up (it appeared to be sufficiently muscular to do this), the post-natal occlusion of the L.T.D. would have been incomplete in this animal. In our specimen of *Colobus occidentalis* the middle of the free border of the A.P. is just caudal to the middle of the C.D., and there is a single fenestration on the cranio-sternal portion of the A.P. In the specimen of *Macacus rhesus* the A.P. extends well cranial to the C.D., the dorsal cornu is more cranial than the sternal, and the L.T.D. opening into the left atrium is to the sternal side and somewhat small; the A.P. is nearly completely apposed. In the second of our baboon fœtuses the cornua are negligible. Our other primates require no special comment.

Nor, on the whole, do our carnivores, with the exception of the bear fœtus, in which the L.T.D. passes almost due left and very little cranially. The others show the usual range of variations in the relation of the A.P. to the C.D., relative lie of the cornua, and so on. The two 10 days post-natal puppies have their A.P.s apposed, but their L.T.D.s are not anatomically closed; that of the one two months post-natal fox cub that we examined is so closed.

When we pass on to the ungulates, we find much more to say, and we realise the aptness of the epithet "tubular" that was first applied to the L.T.D. by C. F. Wolff, the embryologist, in 1776. In the elephant fœtus the A.P. is still fairly simple, the dorsal cornu is more cranial than the sternal one, and the A.P. contributes about half the circumference of the opening of the L.T.D. into the left atrium. From the free border of the A.P. a number of "guy-ropes" pass to the atrial wall. Such guy-ropes have been described and pictured already in connection with the fœtal lamb (Franklin *et al.*, 1940); their precise function is open to conjecture, but they are to be seen in many ungulates. In our camel fœtus the A.P. is pigmented black and shows up clearly against the light-coloured parts around it. It contributes about half of the circumference of the L.T.D. opening. Like the elephant A.P., it can be regarded as not generally different from the primate-carnivore type in its general features. We come next to the deer, goat, pig, and sheep fœtuses, in which the A.P. commonly reaches an appreciable distance cranial to the C.D., and contributes more than half the circumference of the L.T.D. opening (in the deer about 3/5, in the goat about 3/4, and in the pig and sheep on occasion as much as 6/7, though individual variations are possible in each genus). These two points ensure a very obvious tubular character to the L.T.D. In the sheep, as we have said, there are guy-

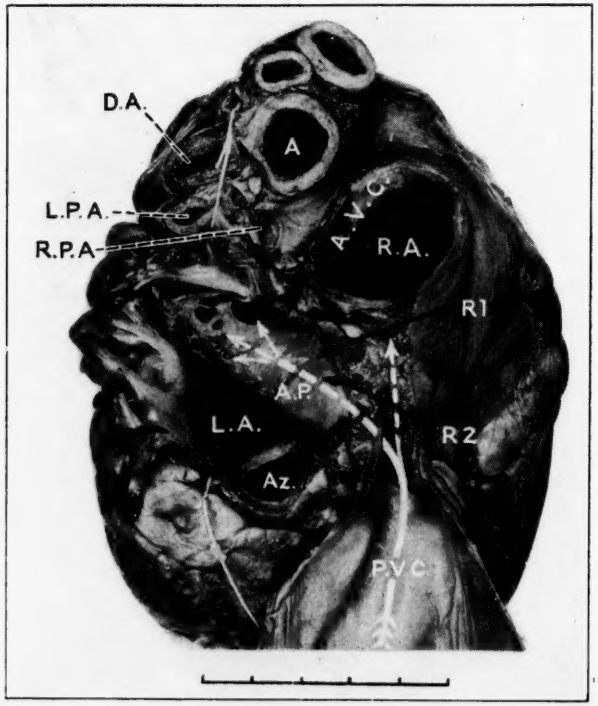

FIG. 3.

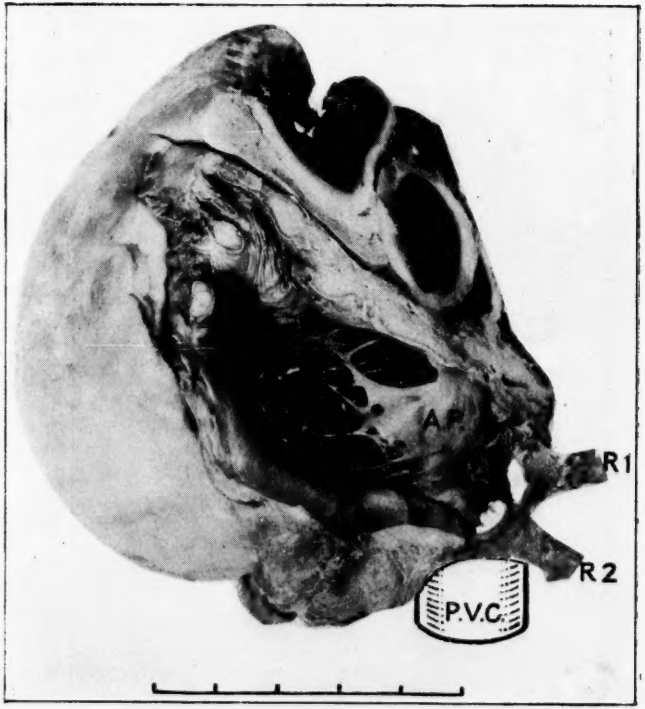

FIG. 4.

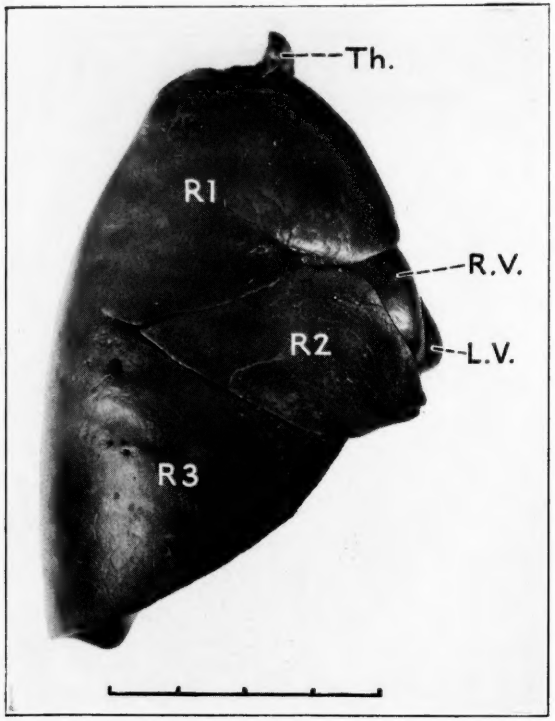

FIG. 5.

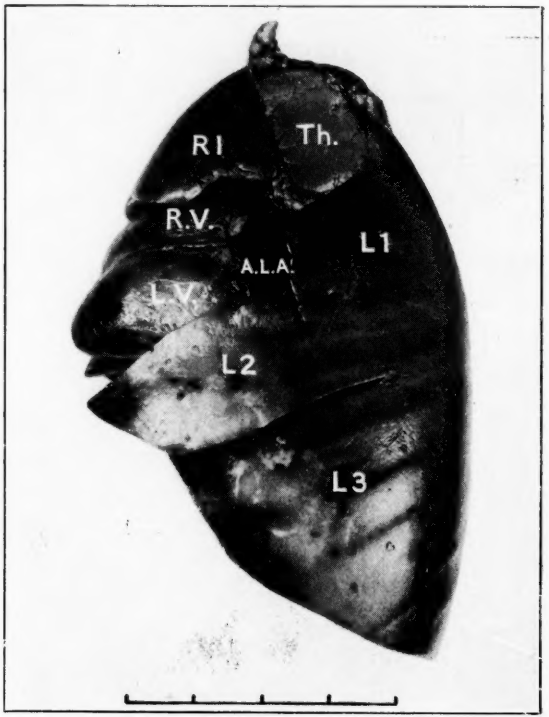

FIG. 6.

ropes, and the cranial end of the A.P. also tends to be fenestrated. The manner in which the A.P. becomes apposed in this genus is easily demonstrable in some of our specimens but would be difficult to explain in words, or even in figures, though it could be done, and we have partly so done it, by means of stereo-photographs (see Franklin *et al.*, 1940). Here we content ourselves with stating that the process is not haphazard, but the tube is packed flat in three successive stages so that (i) the L.T.D. is completely occluded, and (ii) the tube can re-open rapidly if circumstances so dictate. It is difficult for anyone unacquainted with such specimens to imagine that the apposed A.P. can open out almost instantaneously and reveal a large tubular L.T.D., and more difficult still for such a person to envisage the reverse process occurring at speed. But the successive steps can be convincingly demonstrated.

A still more complicated A.P. is found in the fœtal calf (Fig. 3). The L.T.D. tube in this genus is very long and may reach right across the left atrium. The F.P. reaches for some distance on the cranial side, but the terminal portion even on this side is contributed by the A.P. alone. The tube often, though not invariably, has no comparatively wide single opening to mark its termination, as it has in the sheep fœtus, but is provided in its distal half or so with a large number of fenestrations. The appearance in some specimens (see, e.g., Fig. 3) justifies Kilian's (1826, legend of his Fig. 5) earlier description of it as being like the finger of a glove; we ourselves, in view of the fenestrations, would improve on Kilian to the extent of likening it to a worn-out finger stall. We cannot give, as we can in the case of the lamb, the stages in which this remarkable A.P. is apposed to occlude the L.T.D., but the process is effectively carried to completion, as some of our specimens show.

More free-lying still is the A.P. in the tapir, hippopotamus and horse* (Fig. 4). In all these animals the L.T.D. goes to the left and somewhat dorsally, and also bends round so that its final course is at an appreciable angle to that of the P.C.C. The bending is least in the tapir, in the hippopotamus and horse it is nearly to a right-angle. In our tapir fœtus the A.P. lies completely free at its distal end and has one large opening into the left atrium. This opening has a sort of lid that is free to close it, the "hinge," so to speak, being on the medial side and the "lid" being directed cranially in the open position. But we do not wish to imply that we consider the closing of this lid to be the only apposition undergone by the A.P. after birth. So far as we can judge from our hippopotamus specimens, the A.P. itself is attached over part of the dorsal wall of the left atrium, though this area of attachment may perhaps more correctly be regarded as F.P. The free portion of the A.P. to the left of this area may have guy-ropes attaching it to the dorsal and lateral walls of the atrium. The A.P. is fenestrated, and the fenestrations in the main face sternally. In the horse the bulk of the L.T.D. is provided by the free-lying A.P., and this A.P. is fenestrated in the extreme in its terminal portion, forming thereby a structure that is arresting in virtue of its sheer beauty (see Fig. 4).

*Mr. C. W. Ottaway, of the Royal Veterinary College, in his investigation of the manner of closure of the A.P. in the horse, accumulated a small number of specimens which he very kindly placed at our disposal when he learned that we were making the present comparative study. He anticipated us in seeing the fenestrations of the A.P. in this genus and, while we can claim to have advanced a considerable distance from this point, that does not affect our appreciation either of his lead or of his very generous gesture.

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Our main reason for introducing the term "apposable portion" of the left terminal division of the posterior caval channel was to interpret structure in terms of function. It is apparent, however, that in this instance we have further justification, for some at least of the ungulate A.P.s would be very inappropriately designated as "valves."

The Lobation of the Lungs

In our series of fœtuses the typical right lung has four lobes and the typical left lung three lobes. They are well shown in the fœtal lambs (Figs. 5-8), though in this genus and in some others the most cranial lobe on the right side overlaps the sternal mid-line and there is a corresponding reduction in the more cranial part of the left lung. On each side, if we follow the terminology used by Sisson (1940), there are apical, cardiac, and diaphragmatic lobes; on the right side, in addition, there is an intermediate, or mediastinal, or azygos lobe. The separation of the apical and cardiac lobes is usually better marked on the right side than on the left side.

We are not concerned here with listing and explaining all the variations from the typical lobation that we have encountered. We may, however, insert a few notes.

In each of our human specimens there are three lobes on the right, the absence of the intermediate lobe being, presumably, associable with the extreme shortness of the thoracic inferior vena cava. The three lobes are largely separate, in one specimen almost completely so. On the left side there is more or less complete fusion between what would be the apical and cardiac lobes of lower animals, but it is not unusual to get partial indication of the limits of the two areas. The left apical-cum-cardiac portion is more or less well separated from the part corresponding to the diaphragmatic lobe of lower animals. In our gorilla fœtus there are four lobes on the right side, and they are well, though not completely, separated from each other. The fourth lobe is presumably a lobus intermedius, but it lies completely dorsal to the short thoracic inferior vena cava. The left lung is completely divided into two, the more cranial part corresponding to the apical and cardiac lobes of other animals. In our adult gorilla the arrangement is in general similar, but the right apical and cardiac lobes are completely separate, while the lobus intermedius is relatively small and is more fused with the right diaphragmatic lobe than it is in the fœtal specimen. The more cranial half of the left lung is partially divided by a fissure on its left surface into large apical and small cardiac portions. The *Colobus occidentalis* specimen has nine lobes on the right and four on the left, but these can without much difficulty be grouped to correspond with the typical lobation. In the baboons there are four lobes on the right side, and these are all completely separated from each other. The four monkeys are somewhat similar, but vary in the degree of separation of lobes, especially in respect of the left apical and cardiac lobes.

In all the carnivores that we have examined there is a complete, or all but complete, separation of the four lobes on the right side. We imagine this may be typical of the order as a whole. On the left side there are three lobes, the diaphragmatic one being almost invariably separate, and the apical and cardiac varying in their degree of fusion but being always to some extent differentiable.

The ungulates as a whole present no common plan, but certain of them can be grouped together. In the elephant fœtus (Amoroso *et al.*, 1941) the seven lobes can be differentiated with some difficulty and with some residual uncertainty, lobulation being more marked a feature than lobation. In the horse, also, the lungs are not lobated in the usual way, and Sisson differentiates, on each side a body and apical portion, and on the right, in addition, a lobus intermedius. The hippopotamus resembles the horse, and so does the tapir (at least in respect of the left lung; the right lung had been removed from our specimen before we received it). The camel's lungs, too, present a picture that is in general similar to the equine, but the right apical lobe overlaps somewhat the sternal mid-line, an arrangement that is characteristic not of the horse, but of the sheep and allied genera. The bovine is very like the ovine, and so is the goat. The pig is not dissimilar, but the mid-line overlap of the right apical lobe is not apparent.

In our single whale fœtus the lungs resemble in their arrangement those of the horse, but there is no distinguishable lobus intermedius.

In general, then, on macroscopic appearances and without reference to embryology, we can divide all right lungs into three or four lobes, or equivalent masses, the fourth lobe, when present, being the lobus intermedius; and we can divide all left lungs into three lobes, or equivalent masses. For brevity we shall hereafter refer to these respective lobes or masses as R 1, R 2, R 3, R 4, and L 1, L 2, L 3, 1 being apical, 2 cardiac, 3 diaphragmatic, and 4 intermediate.

The Pulmonary Venous Drainage and the Relation of Pulmonary Vein Entries to the A.P., or Valve of the Foramen Ovale

In general the pulmonary venous distribution follows very closely the lobation of the lungs, and we have noted only very minor, and very few, encroachments of pulmonary veins on to what might be regarded as the drainage territories of their neighbours. This is of some importance, for it means that we can, if necessary, use the pulmonary venous distribution as some guide to lobation.

The pulmonary vein entries into the left atrium are arranged in groups (see below; also Figs. 9 and 10), and throughout our series of fœtuses the group through which the blood from R 1 and R 2 enters is in intimate relation to the A.P.; in only one, or possibly two, of our genera (hippopotamus certainly, possibly also the whale) is any other pulmonary vein so related to the A.P. (see below). The relation is such that the pulmonary veins in question and the L.T.D. share a large common opening into the left atrium, and a variable amount of the dorsal part of the A.P. is interposed between the L.T.D. stream and the pulmonary stream coming from R 1 and R 2 (see Fig. 12). As the surround of the common opening is fairly strong and the A.P. itself (see, e.g., Fig 12) a comparatively tenuous structure, the relation means that the calibre of the pulmonary stream bed can increase only at the expense of that of the L.T.D., and vice versa. This fact—the publication of which is our main object in writing—has not, we believe, been noted by any earlier workers. We may even go farther, in view of the evidence available (Barclay *et al.*, 1939; Barcroft *et al.*, 1940), and regard the L.T.D. as performing in utero the functions that are performed post-natally by the pulmonary veins, i.e., it brings oxygenated blood to the left atrium for distribution by the aorta. For Barclay *et al.* showed that the bulk of the

posterior caval inflow goes through the L.T.D. to the left heart, and Barcroft *et al.* that the carotid arterial blood (i.e., blood that enters the aorta from the left heart and is unmixed with blood from the right heart, which enters the aorta, via the ductus arteriosus, distal to the origin of the brachiocephalic artery) is 88 p.c. saturated with oxygen in the sheep fœtus still in utero. Needham (1667)

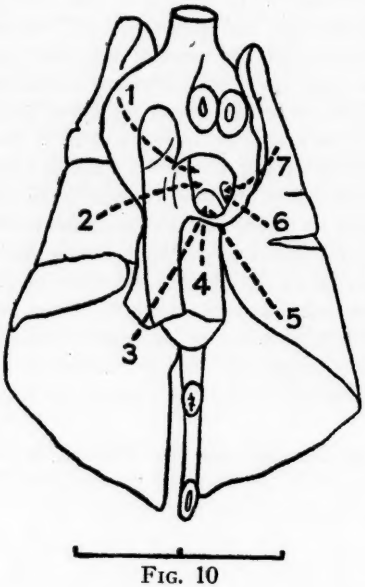

FIG. 10

called the placenta the uterine lung; we may regard the posterior caval channel, and especially the L.T.D., as the termination of the vein from this uterine lung. It is appropriate, then, that the L.T.D. should vary inversely in calibre with the common entry of some of the veins that post-natally fulfil the same function, namely the return of oxygenated blood to the left atrium. That the other pulmonary venous streams aid in the post-natal apposition of the A.P. is suggested by their directions, in so far as one can determine these in our dead specimens.* But it is normally only the stream from R 1 and R 2 that is in the special relation, above-described, to the L.T.D. and its A.P. We may now pass to details.

In the human fœtus there are four pulmonary vein entries, namely, right and left cranial and caudal (see Fig. 2). The right cranial entry receives the blood from R 1 and R 2, the right caudal that from R 3, the left caudal that from L 3, and the left cranial that from the more or less fused L 1 and L 2. In the gorilla fœtus and adult gorilla the entries of the veins from R 1 and R 2 are more widely separated from one another than in the human, but both are in

* A special case is that of the elephant fœtus, where all the pulmonary venous blood enters a special sinus and must flow past the A.P. (Amoroso *et. al.*, 1941); in this specimen, nevertheless, the entry for the blood from R 1 and R 2 shows its normal, very intimate relation to the A.P.

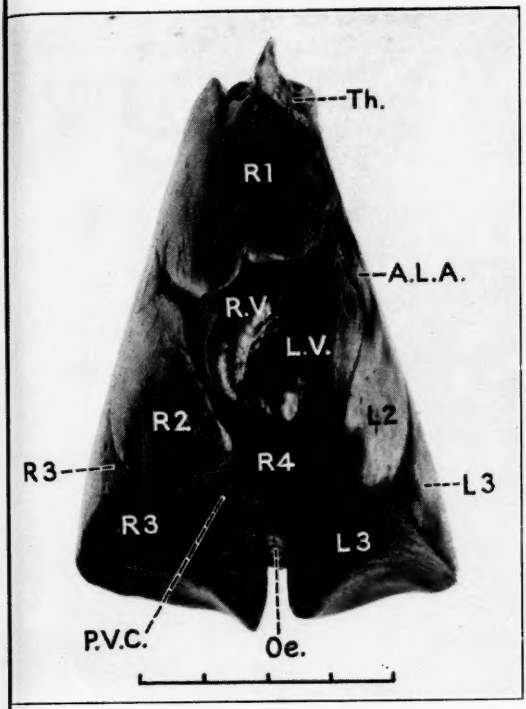

FIG. 7.

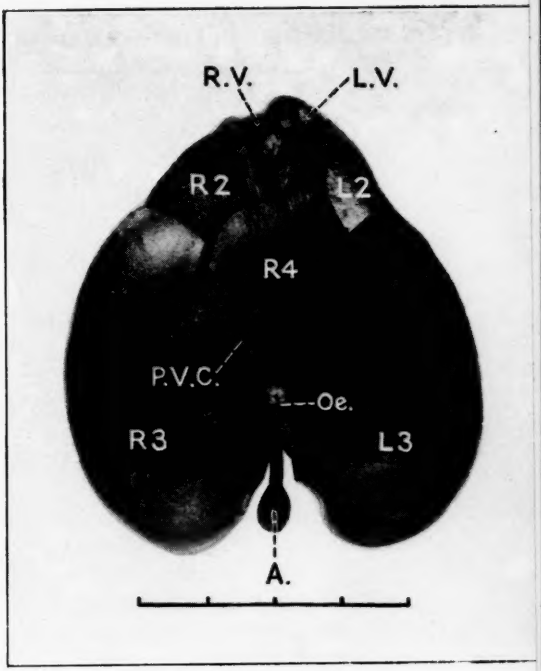

FIG. 8.

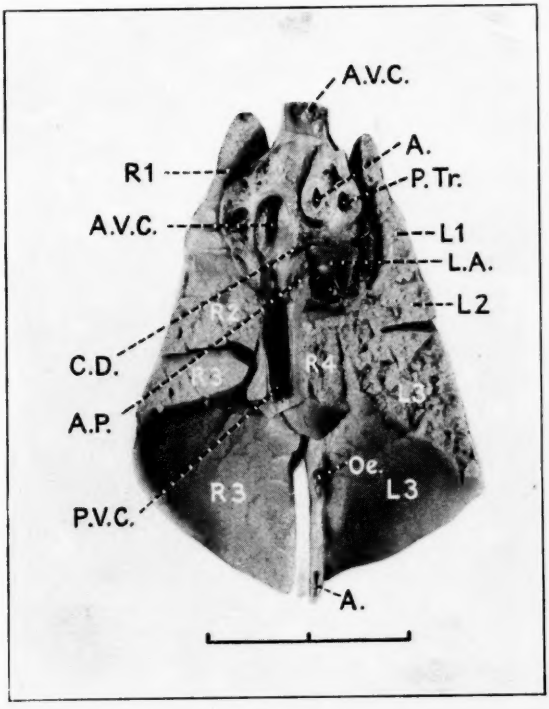

FIG. 9.

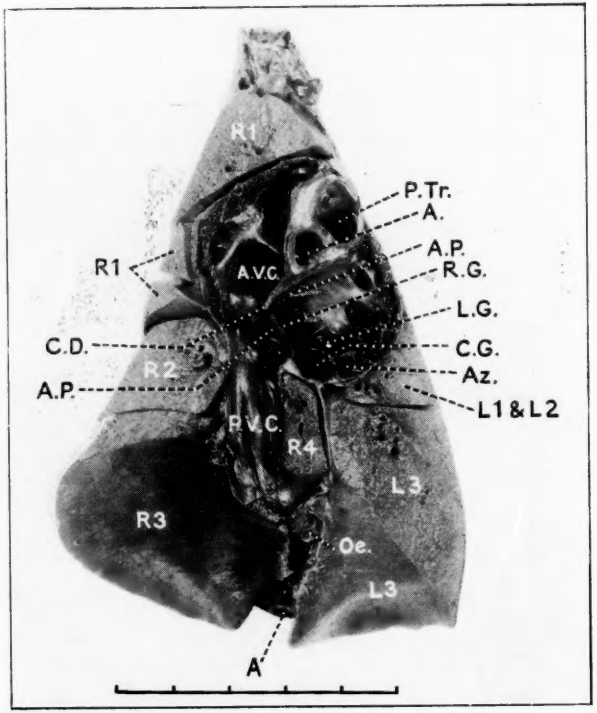
R1
P.Tr.
A.
A.P.
R.G.
R1
A.V.C.
L.G.
C.D.
C.G.
R2
Az.
A.P.
L1 & L2
P.V.C.
R4
L3
R3
Oe.
L3
A

FIG. 11.

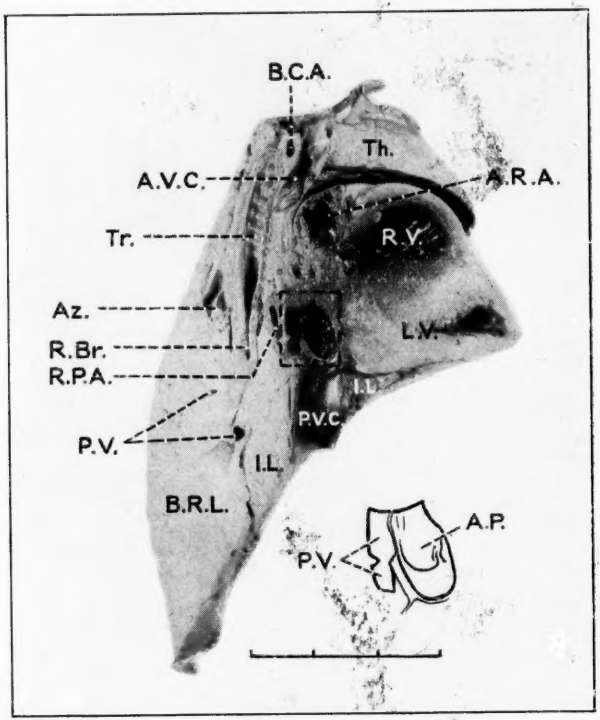
B.C.A.
Th.
A.V.C.
A.R.A.
Tr.
R.V.
Az.
L.V.
R.Br.
R.P.A.
I.L.
P.V.C.
P.V.
I.L.
B.R.L.
A.P.
P.V.

FIG. 12.

the intimate relation to the A.P. Through the right caudal entry comes the blood from R 3 and R 4; through the left caudal, in the fœtus, that from L 3, and through the left cranial that from the more or less fused L 1 and L 2. In our adult gorilla—exceptionally, we must believe—the streams from L 3 and L 2 have a common entry, and that from L 1 has a separate entry. In our *Cebus fatuellus* specimen the entries are, apparently, similar to those in the adult gorilla. The other primates examined by us are more typical, with the streams from L 1 and L 2 entering separately from that from L 3.

In the carnivores and ungulates in general we distinguish three groups of pulmonary vein entries (see Figs. 9, 10 and 11), namely, a right group receiving from R 1 and R 2, a caudal group receiving from R 3, R 4, and L 3 (the vein from R 4 commonly entering that from R 3, but occasionally that from L 3), and a left group receiving from L 1 and L 2. In some ungulates, part of the sternal portion of the common surround for the L.T.D. and right group entry is contributed by the ridge in which lies the large coronary sinus, and the caudal and left groups are separated by a minor ridge running from the main ridge of the surround in question (see Fig. 11). The coronary sinus is large in some of the ungulates (e.g., ovine and bovine) because the main azygos drainage empties into it via the oblique vein of Marshall; in some animals the sinus is even larger, for the oblique vein carries the left anterior caval drainage. But these peculiarities make no difference to the main picture.

In the hippopotamus fœtus the opening of the vein draining R 3, in addition to the openings of those draining R 1 and R 2, is in intimate relation to the A.P. It may be that the whale fœtus is similar in this respect, but a final decision on the point will have to wait until later, for the complete dissection of this specimen, on account of its intra-vascular injection, will be prolonged.

Summary

1. The authors have examined a large number of fœtuses and early post-natal specimens, and also some adult ones, mainly from the orders ungulates, carnivores, and primates.

2. New functional terms are proposed for some parts of the fœtal cardio-vascular system.

3. Some details are given about the variability in form of the valve of the foramen ovale. It is relatively simple in the primates and carnivores; but is very complex in some ungulates.

4. The typical right lung has three or four lobes or equivalent masses, and the typical left lung three lobes or equivalent masses. These lobes are, on each side, apical, cardiac, and diaphragmatic; and on the right side, in addition, an intermediate or mediastinal or azygos lobe.

5. The pulmonary venous distribution runs parallel with the lobation, and there is an intimate relation between the entries of certain veins from the right lung and the valve of the foramen ovale. The relation is such that the pulmonary venous channel from the right apical and cardiac lobes shares with the left terminal division of the posterior caval channel a common entry into the left atrium. Hence temporary increase in calibre of either channel must be accompanied by decrease in calibre of the other channel. This is of interest, as the

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pre-natal function of the posterior caval channel, and in particular of its left terminal division, is largely the same as the post-natal function of the pulmonary venous channels, namely, delivery of oxygenated blood to the left atrium for transmission via the aorta.

Acknowledgments

We wish to thank Colonel J. Hammerton, of the Zoological Society of London, and Dr. A. H. T. Robb-Smith, for certain of our specimens.

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LEGENDS FOR FIGURES

FIG. 1.—Diagram to illustrate that part of the authors' new terminology which is pertinent to this paper; the diagram may be compared with Ziegenspeck (1905), Fig. 2. The posterior vena cava, *P.V.C.*, and right and left atria, *R.A.*, *L.A.*, of a fœtus which has a Eustachian valve are pictured as if they had been divided by a side to side cut in the long axis of the vena cava, and we are shown the resulting view towards the atrio-ventricular openings. The *posterior caval channel* includes not only the lumen, *1 2 3 4*, of the posterior vena cava itself, but also its undivided intra-cardiac continuation, *3 4 5*, and its *left* and *right terminal divisions*, *4 5 6 7* and *3 5 8 9*, through which the posterior caval blood discharges into the left and right atria respectively. The posterior caval channel bifurcates on the *crista dividens* or *dividing ridge*, *5*. The left terminal division is formed by a *fixed portion*, *4 5 6*, and a *free* or *apposable portion*, *4 6 7*, with an attached border, *6 4*, and a free border, *6 7*. This apposable portion is the so-called "valve of the foramen ovale."

FIG. 2.—Semi-diagrammatic drawing made from a nearly full-term human fœtus. Parts of the left ventricle, atrium, and lung have been removed to show the valve of the foramen ovale and the relation to it of the pulmonary vein entries. *P.V.C.*, posterior (inferior) vena cava. *C.D.*, crista dividens, or dividing ridge. *A.P.*, valve of the foramen ovale, or apposable portion of the left terminal division of the posterior caval channel, with its attached and free borders, and sternal and dorsal cornua formed by the cranial coalition of these borders. *P 1*, right cranial pulmonary vein; the entry of this vein into the left atrium is in intimate relation to the *A.P.* (see text). *P 2*, right caudal pulmonary vein. *P 3*, left cranial pulmonary vein. *P 4*, left caudal pulmonary vein. The arrows indicate the approximate directions of the blood streams of *P 1* and *P 2*. *L.L.*, cut left lung. *L.A.*, cut left atrium. *L.V.*, cut left ventricle. Centimetre scale.

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FIG. 3.—Fœtal calf, stillborn. Photograph of part of the heart, etc. Before the specimen was fixed, the posterior vena cava, *P.V.C.*, was slit open, the dorsal wall of the left atrium, etc., was removed, and the left terminal division of the posterior caval channel packed in the open position. We are shown the resulting view towards the apex of the heart. Part of the cut left atrial wall is retracted cranially, thereby compressing the ductus arteriosus, *D.A.*, and the right and left pulmonary arteries, *R.P.A.*, *L.P.A.* *A.V.C.*, the terminal portion of the anterior vena cava. *R.A.*, right atrium. *L.A.*, left atrium. *Az.*, the main azygos venous drainage (oblique vein of Marshall) going to the coronary sinus. *A.*, aorta. *A.P.*, the valve of the foramen ovale, or apposable portion of the left terminal division of the posterior caval channel. The white arrows indicate the course of the posterior caval stream and its left and right terminal divisions. The two black arrows, *R 1*, *R 2*, indicate the approximate directions of the blood streams in the pulmonary veins from the right apical and cardiac lobes respectively; the entries of these veins into the left atrium were in intimate relation (see text) to the *A.P.*; the veins themselves were almost completely removed by the cut that exposed the view shown in the photograph, and only small portions of the sternal walls of their entries are visible. Centimetre scale.

FIG. 4.—Fœtal horse, full-term. Photograph of part of the heart, etc. The specimen is incomplete in the right upper part of the figure. Before fixation, the dorsal wall of the left atrium, etc., was removed, and the left terminal division of the posterior caval channel packed in the open position. To show in its entirety the valve of the foramen ovale, *A.P.*, or apposable portion, the photograph was taken from a point somewhat to the left and dorsally. The *A.P.* shows extreme and very beautiful fenestration in its distal part. *P.V.C.*, posterior vena cava. *R 1*, *R 2*, pulmonary veins (packed with cotton wool) from the right apical and cardiac lobes respectively entering the left atrium in intimate relation (see text) to the A.P. Centimetre scale.

FIGS. 5-8.—Fœtal lamb, about 120 days (full-term 147 days). Photographs of exsected thoracic viscera, to show lobation of lungs. Fig. 5: View from right side. Fig. 6: View from left side. Fig. 7: View from sternal side. Fig. 8: View from diaphragmatic side. *R 1*, *R 2*, *R 3*, *R 4*, right apical, cardiac, diaphragmatic, and intermediate lobes respectively. **Note that** *R 1* in this genus overlaps the sternal mid-line. *L 1*, *L 2*, *L 3*, left apical, cardiac, and diaphragmatic lobes respectively. *P.V.C.*, posterior vena cava. *A.L.A.*, auricle of left atrium. *R.V.*, right ventricle. *L.V.*, left ventricle. *A.*, aorta. *Th.*, thymus. *Œ.*, œsophagus. Centimetre scales.

FIG. 9.—Fœtal pig, about 90 days (full-term 112-119 days). Photograph of dorsal half of exsected thoracic viscera, divided by a side to side cut in the long axis of the posterior vena cava. *R 1*, *R 2*, *R 3*, *R 4*, right apical, cardiac, diaphragmatic, and intermediate lobes. *L 1*, *L 2*, *L 3*, left apical, cardiac, and diaphragmatic lobes. *P.V.C.*, posterior vena cava. *A.V.C.*, anterior vena cava. *C.D.*, crista dividens, or dividing ridge. *A.P.*, valve of the foramen ovale, divided by the transverse cut. *L.A.*, left atrium. *A.*, aorta. *P.Tr.*, pulmonary trunk. *Œ.*, œsophagus. Centimetre scale.

FIG. 10.—Outline drawing from Fig. 9, with approximate courses of pulmonary veins indicated by interrupted lines. Right group formed by *1* and *2*, the veins draining the right apical and cardiac lobes respectively, which open into the left atrium in intimate relation (see text) to the *A.P.* Caudal group formed by *3*, *4*, and *5*, the veins draining the right diaphragmatic, intermediate, and left diaphragmatic lobes respectively. Left group formed by *6* and *7*, the veins draining the left cardiac and apical lobes respectively. Centimetre scale.

FIG. 11.—Fœtal lamb, about 120 days (full-term 147 days). Photograph of dorsal half of exsected thoracic viscera, divided by a side to side cut in the long axis of the posterior vena cava. To show the entries of the three groups of pulmonary veins into the left atrium. *R.G.*, right group entry, dorsal to the valve of the foramen ovale, *A.P.*, which is apposed in this specimen; this group drains the right apical, *R 1*, and right cardiac, *R 2*, lobes. *C.G.*, caudal group entry; this group drains the right diaphragmatic, *R 3*, right intermediate, *R 4*, and left diaphragmatic, *L 3*, lobes. *L.G.*, left group entry; this group drains the left cardiac and apical lobes, *L 2* and *L 1* respectively. *A.V.C.*, anterior vena cava. *P.V.C.*, posterior vena cava. *C.D.*, crista dividens. *A.*, aorta. *P.Tr.*, pulmonary trunk. *Az.*, main azygos drainage (oblique vein of Marshall). *Œ.*, œsophagus. Centimetre scale.

FIG. 12.—Fœtal horse, 141 days (full-term over 335-345 days). Photograph of the exsected thoracic viscera divided longitudinally, and somewhat obliquely, in the long axis of the posterior vena cava, *P.V.C.* To show that the dorsal portion of the valve of the foramen ovale, *A.P.*, alone separates the left terminal division of the posterior caval channel from the pulmonary veins (*P.V.* in inset) draining the more cranial part of the right lung. *B.R.L.*, body of right lung. *I.L.*, intermediate lobe of right lung. *A.V.C.*, anterior vena cava. *A.R.A.*, auricle of right atrium. *R.V.*, right ventricle. *L.V.*, left ventricle. *B.C.A.*, brachio-cephalic artery. *Tr.*, trachea. *R.Br.*, right bronchus. *Az.*, azygos vein. *R.P.A.*, right pulmonary artery. *P.V.*, pulmonary veins. *Th.*, thymus. The inset is an enlarged outline of the part contained within the interrupted lines. The valve of the foramen ovale is apposed. Centimetre scale.

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MYELOCYTOMA IN THE DOMESTIC FOWL

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In the course of over a thousand post-mortems, extending over a period of two and a half years, two, possibly three, cases of myelocytoma in the fowl have been examined, two in adult birds (both Buff Rocks) and what was probably a case in a young pullet. Unfortunately, as the infrequency of the condition was not appreciated, a full record of findings was not kept, these post-mortems only being represented now by an odd histological preparation or two and a very brief description of the macroscopic appearance.

Recently, however, a third case was examined, and the findings are described in some detail below.

Post-mortem No. 7772

The subject was a 4½ lb. Buff Rock hen, aged two years, which was seen by Mr. Hillock, veterinary surgeon, Haddington. Symptoms of extreme weakness suddenly appeared and the bird was destroyed on the third day of illness, after a period of paralysis.

It was in moderately good condition. As soon as the pectoral muscles and sternum were reflected a large soft white mass (7 x 4½ x 3 cms.), resembling brain tissue, was found growing from the internal aspect of the sternum. Examination of this bone showed that the medullary cavity was greatly enlarged and filled with similar soft white tissue, which appeared to extend diffusely into the overlying pectoral muscles.

The visceral pericardium showed several flattish discoidal growths (0.5 cm.) on its surface, and the parietal pericardium was slightly adherent to these. Transverse section of the heart showed the inter-ventricular septum to be almost entirely replaced by the tumour. The blood was decidedly anæmic and watery.

The lungs were firmly attached to the ribs and intercostal muscles by a thick (1.0 cm.) white mass covering their parietal aspect. Section of the organs showed whitish masses in the interior.

The ovary was enlarged (6 x 6 x 4 cm.), firm, and presented a pinkish-white cauliflower-like appearance.

The kidneys were both involved. The left organ had only a small portion of normal substance left in the posterior lobe, the rest being a soft, white mass of neoplastic tissue, continuous with similar tissue which extended into the depths of the pelvic cavity. The right organ had a considerable part of the upper and middle lobes intact, but the rest were tumorous.

The liver and spleen were not enlarged, but the former had many small whitish areas shining through the capsule.

In the neck region, a string of small growths was found in the site of the thymus, which was, of course, almost completely atrophied. The thyroid and parathyroids were unaffected, although a mass of tumour tissue lay in close proximity to the left glands.

The skeleton was carefully examined after boiling, and evidence of fresh

bone formation found, in the form of masses of small delicate spicules growing from the periosteum of the following bones: Between the fused transverse processes of the lumbo-sacral vertebræ, on the internal aspect of the ileum, and in the bodies of the fused thoracic vertebræ. There was no sign of ulceration or necrosis of the bones and the shaft walls of long bones were slightly thicker than normal. The bone marrow in the long bones had, when fresh, a dirty pinkish appearance and completely filled the medullary cavity as a compact but soft mass.

Histological Characters of the Tumour

The cell type combines myeloblastic and myelocytic characters. When closely packed, as in the centre of the neoplasm, each cell is polyhedral from mutual pressure. Towards the periphery, however, the cells usually tend to be spherical, and when diffusely distributed, as when infiltrating between muscle fibres, etc., are quite spherical or oval. Their average size is 7.2 x 5.7μ. The nucleus is large, vesicular, and has one or two prominent nucleoli. It is generally situated eccentrically in the cytoplasm, in this respect resembling a plasma cell. Mitotic figures are common. (Fig. 1.)

Sections stained with hæmatoxylin and eosin show the majority of cells to have coarse spherical eosinophilic granules lying in the cytoplasm. (If stained with giemsa, however, they are seen to be metachromatic, purple granules lying interspersed with the eosinophilic ones.) Occasional groups of cells show particularly vivid scarlet granules very closely packed in the cytoplasm.

There is but little inter-cellular connective tissue, and blood vessels are few. Circumscribed areas of necrosis are fairly common. The cells tend to be arranged in long strands or columns and occasionally several such columns lie side by side to form broad sheets of cells. (Fig. 2.)

Argyrophil Reticulin Fibrils

These are present as an irregular network enclosing groups of cells in some parts of the tumour (Fig. 3); in other parts they are scanty or not present at all.

The following parts were subjected to a microscopical examination:—

Sternum: A transverse section shows the bone to be badly eroded, with greatly distended medullary spaces packed with cells. The overlying great pectoral muscle is almost completely replaced by these cells, leaving a thin superficial layer of muscle, the fibres of which are widely separated by infiltrating cells. (Fig. 4.)

Femur: Transverse section of this bone shows the medullary cavity filled with tumour cells, scattered amongst which are islands of normoblasts appearing as densely staining nuclei. Evidence of both erosion and new bone formation in the form of spicules is detected in the spongiosa of the shaft. The Haversian and Volkmann canals contain groups of tumour cells, many showing the usual mitotic activity. On the whole, the shaft wall appears slightly thicker than normal and shows a concentric arrangement as though layers of new bone have been laid down internally. (Fig. 5.)

Heart: The cells appear to have infiltrated beneath the pericardium, and, proliferating there, grown inwards in strands and columns between the heart

muscle fibres, separating these widely. Pericardial fat spaces are outlined by masses of cells.

The blood: Unfortunately proved unsatisfactory for microscopical examination, owing to the extreme degeneration of the leucocytes, but the leucocytic " smudges " did not appear to be excessive.

Lungs: Masses of actively proliferating cells have infiltrated along the interlobular septa and ensheathed the pulmonary vessels at the angles of the lobules. They also invade the actual wall of the lobule. (Fig. 6). The cells have extended beneath the parietal pleura and proliferated to a considerable thickness, thus fixing the lung to the ribs and intercostal muscles. Beneath this thick sheet, the pulmonary alveoli are compressed, and many obliterated. The alveolar capillaries in the more normal lobules are seen, under high magnification, to contain many tumour cells, most of which have a greater breadth than the containing capillary, and so distend and block it.

Liver: Tumour cells are present wherever there is connective tissue, burrowing and infiltrating especially round the blood vessels and bile ducts. Adjacent to such areas, the hepatic cells show signs of pressure atrophy, and necrobiosis. Isolated tumour cells are seen lying in the liver sinusoids amongst the erythrocytes.

Ovary: The stroma is almost completely replaced by tumour cells, and only a few isolated distorted ovarian follicles remain.

Kidney: The cells have invaded these organs so completely as to make it difficult to find any normal tissue. The path of infiltration is between convoluted tubules. Many glomeruli are left as prominent islands in a surrounding mass of cells. (Fig. 7.) Spicules of bone are lying in the tumour mass near its pelvic attachment.

Thymus: Traces of this gland remain, but the bulk of the tissue consists of masses of tumour cells, with many isolated necrotic areas.

Spleen: This organ is involved to the extent that tumour cells, many showing mitotic figures, are scattered impartially throughout both red and white pulp. There are occasional groups of cells, but these are quite microscopic. It appears as though the spleen was only lately involved in the general condition. Masses of actively proliferating cells are attached to the surface of the splenic capsule, in the form of macroscopical tumours.

Adrenal gland: Appears quite normal microscopically.

Summary: An unusual type of malignant neoplasm is described in a two-year-old Buff Rock hen. The cell type appears to be an intermediate between a myeloblast, as witnessed by the embryonic appearance of the nucleus, and a myelocyte, judging from the granular nature of the cytoplasm. In view of these characters, the growth would appear to be a myelocytoma, and it seems probable that the primary growth originated in the sternal marrow.

Acknowledgments

I am indebted to Professor Grahame, of the Anatomy Department, for permission to have the photo-micrographs taken, and to Mr. P. G. D. Morris,

FIG. 1: Tumour cells X 1000. Mitotic figure in centre.

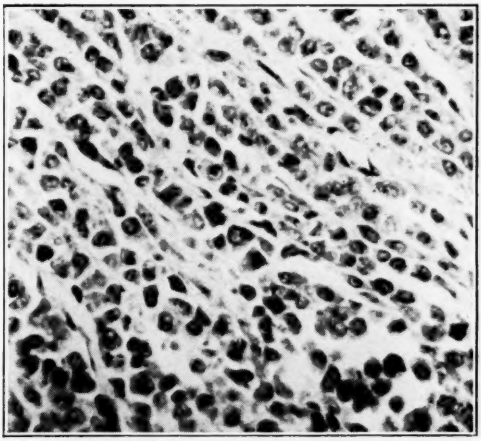

FIG. 2: Strands of cells, with delicate connective tissue fibres in Ovarian tumour.

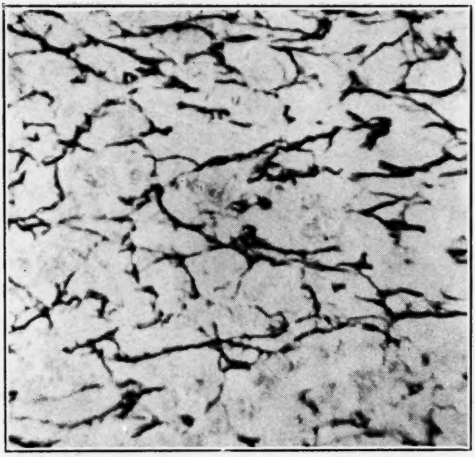

FIG. 3: Argyrophil reticulin fibrils surrounding groups of cells.

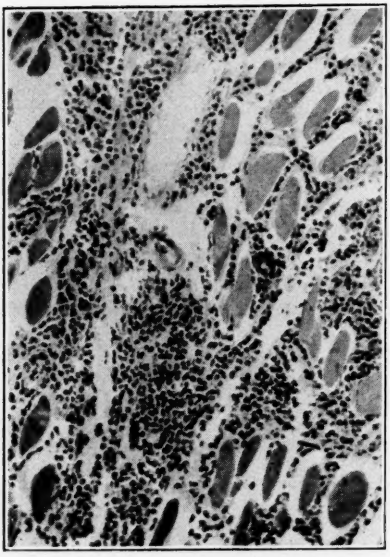

FIG. 4: Pectoral muscle fibres separated by infiltrating cells.

FIG. 5: T.S. Femur, showing groups of tumour cells, bone erosion, bone formation, and scattered groups of Normoblasts.

FIG. 6: Cells proliferating in inter-lobular septum, and invading alveolar walls.

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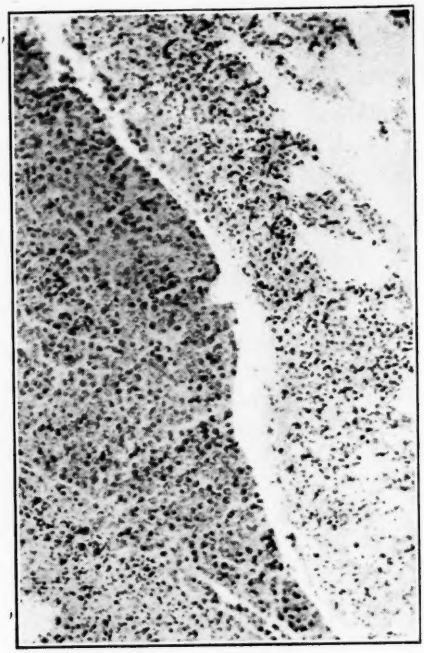

FIG. 6a: Enlargement of Fig. 6.

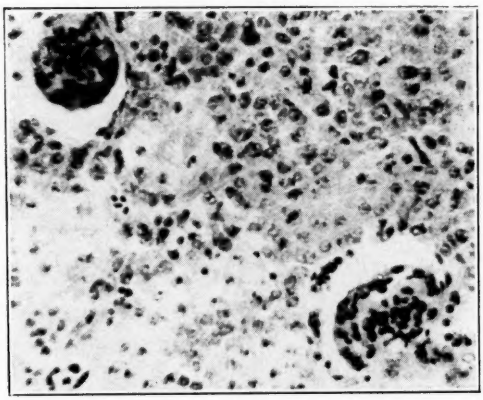

FIG. 7: Cells infiltrating the kidney. The tubles are degenerate.

M.A., M.R.C.V.S., of the same Department, who took such pains over their preparation.

Also I am grateful to Mr. Whittick, B.Sc., M.R.C.V.S., of the Pathology Department, for giving me a second opinion as to the probable nature of the neoplasm.

Abstracts of Current Literature

Barium Carbonate Poisoning in Fowls. By L. G. NEWTON. *Aust. Vet. J.* 1941. *XVII*, 232.

BARIUM carbonate is used for poisoning rats. This article describes poisoning in poultry when a flock of about 300 laying hens were involved. Following their evening feed several birds became seriously ill and some died. During the night more died and, by morning, 105 were dead and 68 were visibly affected. Deaths continued for a week, till 185 birds were dead and nearly all the remainder had ceased to lay.

"The main symptoms noted were darkening of the comb, distressed appearance and incoordination of gait. The important lesions seen on post-mortem examination were congestion of the alimentary tract, with shedding of the lining membranes of the crop and stomach, as well as congestion of the liver."

Chemical analysis showed the following amounts of barium carbonate: crop ingesta, 118.3 grains per lb.; stubblegrass in the crop, 158.3 grains per lb.; wall of crop, 71.1 grains per lb. The sample of food from a feeding trough contained 568.4 grains per lb.

Concerning the toxicity of barium carbonate, the author says: "Lander states that 60 grains of barium carbonate was toxic for a dog, whilst 75 grains of barium chloride per day for five days was fatal to a horse. The weights of the animals are not given. As no figures regarding the toxic dose for poultry could be found, the following tests were carried out:—

"1. Twenty grains of barium carbonate was administered in distilled water by œsophageal tube to a 1,650 g. white leghorn cockerel, causing death in two hours. Incoordination of gait, fluttering of the wings and darkening of the combs were noted. Autopsy showed mild diffuse congestion of the crop and numerous small hæmorrhages in the bowel walls. The presence of ascarids in the crop suggested that antiperistalsis had occurred. The liver was acutely congested.

"2. Ten grains administered to a 1,576 g. bird produced diarrhœa, evacuation of blood and death in four days.

"3. Six grains produced death in a 1,600 g. white leghorn pullet in forty-eight hours, whereas the same dose to a similar bird produced no ill effects.

"4. Three grains produced no ill effects in a 1,600 g. bird. It would appear, therefore, that the toxic dose for a 1,600 g. fowl lies between six and ten grains."

Sulphaguanidine in "White Scours of Calves."*

THE following is reproduced from the *J.A.V.M.A.*, 1942, *c*, 160 :—

"Sulfaguanidine (=sulfanilyl guanidine), one of the sulfanyl derivatives, is becoming recognised as a therapeutic agent for many enteric infections in man and in domestic animals.(1) (2) The use of this chemical compound as a medicament for 'white scours,' an enteritis occurring frequently in animals less than a week of age, has produced encouraging results in all cases we have treated. This disease, also known as 'bacterial scours' or 'infectious diarrhœa,' has not responded satisfactorily to therapeutic agents heretofore employed. Its etiology from a microbiological standpoint is ill defined; its incidence among dairy herds throughout the United States is great, and the mortality is high. Prophylactic methods commonly recommended and generally used frequently fail to prevent this fatal diarrhœa.

"Five cases of calf diarrhœa, definitely diagnosed as the classical 'white scours,' have recovered miraculously as a result of the administration of several doses of sulfaguanidine in aqueous suspension. Two of these cases had received 'anti-coli-enteritidis-pasteurella serum' of bovine origin, but this failed to prevent the disease. Chemotherapy in all cases was initiated immediately after the first positive symptoms of 'white scours' were manifested. The dosage schedule per 100 lb. bodyweight was as follows :—

	Time interval	*Dosage*
No. of dose	*Hours*	*Grams*
First	Initial	5.0
Second	4	3.5
Third	6	2.5
Subsequent	6	2.5

"The treatment was continued until the diarrhœa definitely subsided, which was usually a short time after giving the third dose. However, in one case only one dose was necessary, whereas, in another, four doses were required.

"The treated calves remained weak and without appetite for about two days following cessation of the diarrhœa. In order to provide nourishment to two of the calves during the recuperative period it was necessary to drench them with milk, drawn from their respective dams. Within three days following the sulfaguanidine treatment, no abnormal clinical symptoms were evident. A male calf that had recovered was sacrificed for autopsy, which revealed a slight catarrhal condition of the colon and a small hæmorrhagic area in the fundus of the abomasum. Neither of these conditions was considered pathologically serious.

"Though these preliminary results from the use of sulfaguanidine as a remedy for this type of scours are promising, much additional information is needed to establish the applicability of this drugs in ths treatment of various other types of calf diarrhœa.

GEORGE H. WISE and G. W. ANDERSON, Clemson College, S.C."

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*Technical Paper No. 87 of the South Carolina Agricultural Experimental Station.

(1) Cameron, H. S., and McOmie, W. A.: "Blood concentration studies on sulfaguanidine in swine and pigs." *Cornell Vet. XXXI* (1941), pp. 161-163.

(2) Levine, P. P.: "The coccidiostatic effect of sulfaguanidine (sulfanilylguanidine)." *Cornell Vet. XXXI* (1941), pp. 107-112.

The Feeding of Corn Cockle to Chickens. By G. F. HEUSER and A. E. SCHUMACHER. *Poultry Science.* 1942. *XXI,* 86.

THE toxic substance in corn cockle is known as githazin, saponin, agrostemmin, sapotoxin or smilacin. It is a saponin-like glucoside and the poisonous principle is said to be present in all parts of the plant but mainly in the seeds. It is destroyed by heating to 50 deg. Cent.

The authors carried out a series of experiments, of which the following is a summary of the results :—

1. Birds affected with corn cockle poisoning present a generally listless and unkempt appearance with rough feathering and diarrhœa. Characteristic lesions of cheesy material in the mouth and under the tongue were present.

2. In the feeding of ground cockle to chicks no effect was observed on the average weight at six weeks of age until more than two per cent. of ground cockle was added to the feed. Lesions in the mouth, however, were present even when 0.25 per cent. was fed. Two per cent. of the feed which resulted in the consumption of an amount equal to 0.3 per cent. of the bodyweight appeared to be toxic : four per cent. of the feed or 0.5 per cent. of the bodyweight caused mortality.

3. In the feeding of ground cockle to older birds (6 to 10 weeks of age) five per cent. in the ration or 0.3 per cent. of the bodyweight was toxic. However, a tolerance to the poison was developed so that later 0.4 to 0.5 per cent. of the bodyweight could be consumed without affecting growth. Ten per cent. of the ration or 0.8 per cent. of the bodyweight was lethal to some of the birds.

4. Cockle poisoning decreased the respiratory rate and heart rate of the birds. Body temperature and real blood cell count were not affected.

5. The feeding of unground cockle in the case of both young and older chicks had no apparent effect upon the birds, even though the intake of cockle was as large as that of birds which were definitely affected by the ground cockle. The consumption of the whole cockle amounted to 3.5 per cent. of the food intake in the case of the younger chicks and 5.9 per cent. in the case of the older birds.

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Notices

THE manufacturers of the well-known farm antiseptic Deosan (Red Label for dairy use—Blue Label for general use) have announced that in future they will be known exclusively by the name Deosan, Ltd., and not, as before, Electrolytic Chemical Products, Ltd.

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